Croaker and Red Drum Aging Workshop

South Carolina Department of Natural Resources
Marine Resources Center
Charleston, South Carolina

October 8, 2008

Workshop Proceedings

Workshop Participants

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Meeting Summary

C. McDonough (SC DNR) and P. Campfield (ASMFC) welcomed participants to the Marine Resources Center at 8:00 AM. Pat briefed the group on objectives for the aging workshop. The purpose of the workshop was to compare methods in sectioning and reading otoliths from red drum and Atlantic croaker to establish common age interpretation methods coast wide. Although most annuli are distinct and easy to interpret, it is sometimes a challenge to identify the 1st annulus for both species. Fish spawned in late summer vs. winter lay down the 1st mark at different times, making age interpretation difficult.

Aging experts from several states brought prepared slides of otolith sections to exchange for aging comparisons. Samples represented a broad range of age classes, seasons, and geographic coverage. Participants reviewed processing methods and conducted aging comparisons among regions and readers. Digital otolith reference collections were established utilizing select samples from each state. This ASMFC Aging Workshop Report describes results and provides a standard protocol to guide current and future aging analysts. Atlantic croaker was covered in the morning session, and red drum in the afternoon.

Atlantic Croaker

C. McDonough presented an overview of croaker otolith processing and reading protocols used by SC DNR staff. The issue of determining when the 1st annulus is laid down was discussed at length. For the purposes of stock assessments and other coast wide analyses, the decision was made to count the 1st distinct ring as the 1st annulus, and not count any 'check marks' that occurred in close proximity to the core of the otolith as an annulus. This decision was based on the practice of not counting any 'check marks' near the core by all states except VA. These check marks are not present on all otoliths. Atlantic croaker has an extended spawning season (July through December in the Chesapeake Bay region, October through March along the South Atlantic Bight) and generally have not reached 1 year in age after the first over wintering period. Most temperate and warm temperate fishes put down an annulus in late spring and early summer in the northern hemisphere. Given the potential birth-date for an Atlantic croaker born between October and March, this check mark can potentially be put down between 3 and 8 months of age. The first true annulus is put down at the end of the second over-wintering period (Fig 1). The primary reason for not counting this 'check mark' as the first annulus is that, if used to assign year-class, the fish would be assigned to the wrong year-class thus shifting the age distribution. It was noted historical age data from Virginia (VMRC/ODU and VIMS) would need to be reviewed and possibly adjusted by 1-year to account for this difference.

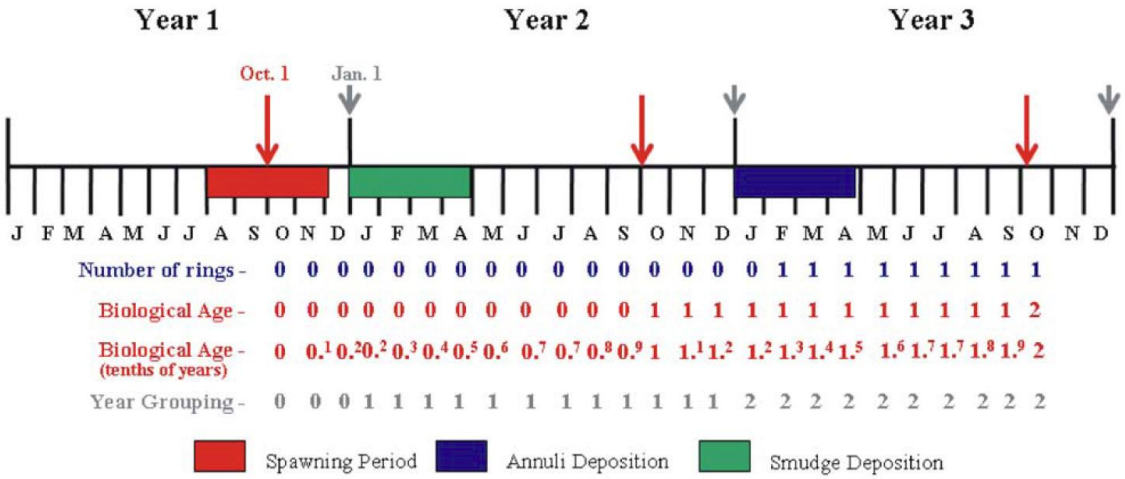


Figure 1: Timing of ring formation in Atlantic croaker relative to biological (red) and model (grey) birthdates. From the GSMFC *A Practical Handbook for Determining the Ages of Gulf of Mexico Fish 2nd Edition.*

Age comparisons among readers

Sets of prepared croaker otolith sections from each state from Georgia to New Jersey, and the NEFSC, were read by the state's aging expert to determine ages. Then, slides were exchanged and read by all other agers. Specimen collection number and date were recorded, along with determinations of number of annuli, age, and year class. Each slide was read by most of the other participants. Some otoliths were read by two experts from the same state; when the ages assigned by readers from the same state differed, an average age was assigned for that state in the state-to-state comparisons. Readers were instructed to not count the 'check mark' laid down near the otolith core.

Average Percent Error (APE, Eq. 1) was used to estimate the precision (i.e., consistency) of age determination between states.

$$APE = \frac{1}{N}\sum_{j=1}^{N}\left[\frac{1}{R}\sum_{i=1}^{R}\frac{\left|a_{ij}-\bar{a}_j\right|}{\bar{a}_j}\right] \quad (1)$$

Where N is the total number of otoliths read, R is the total number of readers that aged individual otolith j, a_{ij} is the i^{th} reading of the j^{th} otolith, and $\bar{a}_j$ is the average age assigned to the j^{th} otolith.

APE was calculated for all samples pooled together, to estimate overall precision, and by state, to estimate whether certain states deviated from the mean more often or to a greater degree.

Age bias plots were prepared to examine the possibility of bias across state readers. Most states' readings agreed and did show clear patterns in the age bias plots when readings disagreed, with the exception of South Carolina. SC readings agreed with the other states in most cases, but when they disagreed, SC's assigned age was consistently lower. SC had the highest APE (Table 1), which was most likely driven by 7 samples for which other states assigned an age of 1 and SC assigned an age of 0. The

SC readers at the workshop had never aged croaker before, and these discrepancies are consistent with inexperienced readers who were in some cases too conservative in identifying the first annulus.

Table 1: Average Percent Error for Atlantic croaker age estimates

State	*Average Percent Error (APE)*
New Jersey	12.6%
Virginia	9.1%
North Carolina	16.8%
South Carolina	18.1%
Georgia	11.2%
Florida	9.6%
Overall	12.6%

Red Drum

C. McDonough presented an overview of red drum otolith processing and reading conducted by SC DNR staff at the facility in Charleston. Participants from each state briefly described their otolith processing methods. Minor differences in cutting and polishing were noted but it was determined all produce easily readable otoliths. The group discussed reliability of scale aging. Scales appear to be accurate through Age 4 and are not reliable thereafter; otoliths should be used for Age 4 fish and older. The issue of determining 'birth date' and proper assignment of correct year-class was discussed at length. For assessment modeling purposes, the decision was made to use January 1 as the birth date of all drum, regardless of differences among hatch dates among regions. For life history analyses (e.g., natural mortality estimation), a standard biological birth date of October 1 will be used (Figure 2).

The decision was made to count the 1st distinct ring as the 1st annulus, and to not count any 'check mark' in close proximity to the core as an annulus. This decision was based on the practice of not counting the 'check mark' by all states except Georgia. The reason for this is biological. Red drum spawn in August and September and overwinter in deepwater tidal creeks with very little growth during winter. When water temperatures begin to increase in spring and early summer, growth increases and some fish will put down a 'check mark' indicative of this change in growth, however they have not reached one year calendar age. The first annular mark will be laid down the following spring after the fish has gone through its second overwintering period. It was noted historical age data from Georgia would need to be reviewed and possibly adjusted by 1-year to account for this difference.

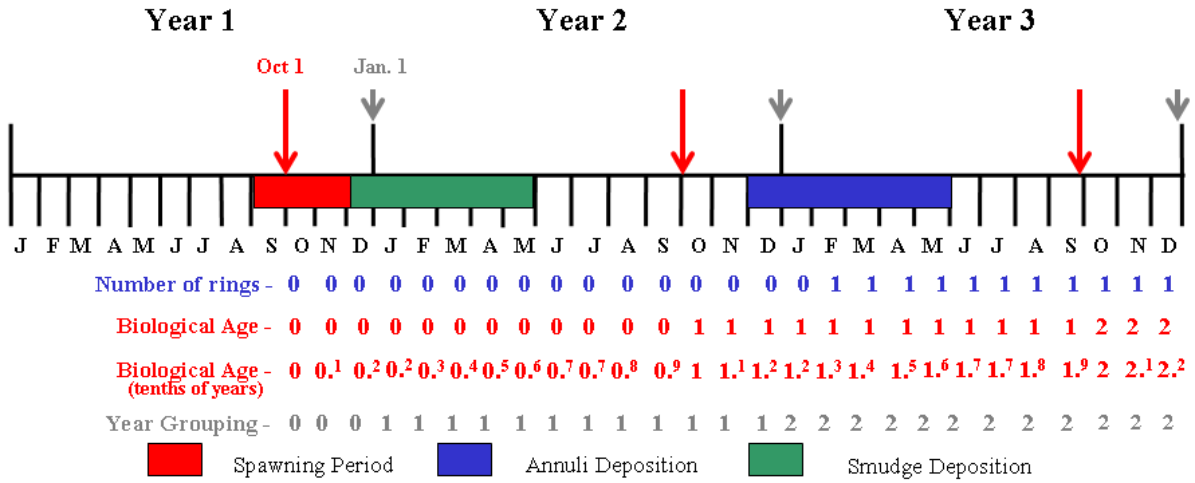


Figure 2: Timing of ring formation in red drum relative to biological (red) and model (grey) birthdates. From the GSMFC *A Practical Handbook for Determining the Ages of Gulf of Mexico Fish 2nd Edition*.

Age comparisons among readers

Sets of prepared red drum otolith sections from each state from Florida to Virginia were read by the state's aging expert to determine ages. Then, slides were exchanged and read by all other agers. Specimen collection number and date were recorded, along with determinations of number of annuli, age, and year class. Each slide was read by most of the other participants. Readers were instructed to not count the 'check mark' laid down near the otolith core

APE (Eq. 1) was also calculated for red drum as a measure of precision.

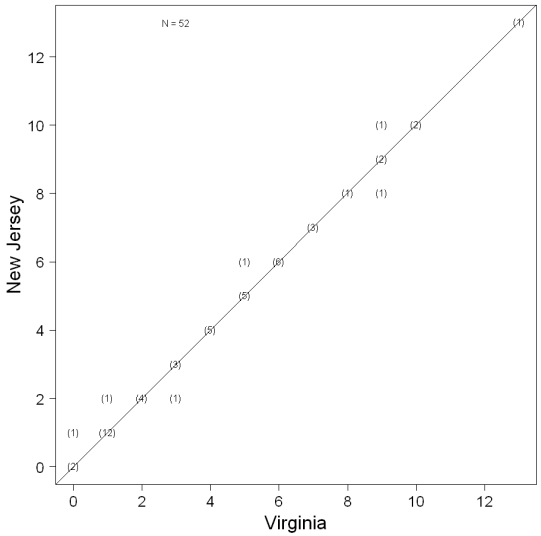
Age bias plots for red drum showed that Virginia consistently over-aged red drum relative to the other states (Fig. 4). Virginia also had the highest APE of the states (Table 2). Virginia acknowledged counting the check near the otolith core, which explained the discrepancy. When VA ages were adjusted downward by subtracting a year, the APE for VA and for the total pooled sample decreased, although the APE for the Carolinas increased.

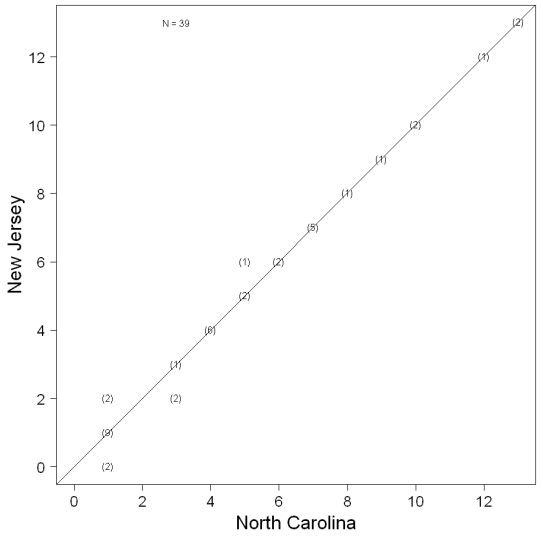
Table 2: Average Percent Error for red drum age estimates. Virginia adjusted ages were produced by subtracting 1 year, to account for the practice of counting the check mark near the otolith core as an annulus.

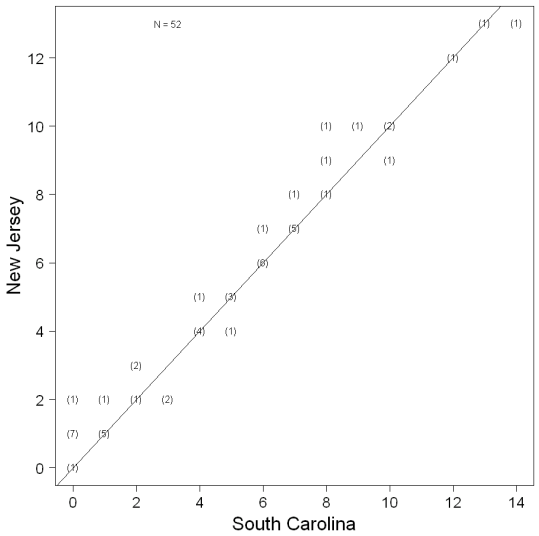
	Average Percent Error (APE)	
State	Original	VA Adjusted
Virginia	28.2%	8.5%
North Carolina	13.4%	14.0%
South Carolina	13.0%	15.1%
Georgia	15.8%	12.8%
Florida	13.6%	10.8%
Overall	16.6%	12.5%

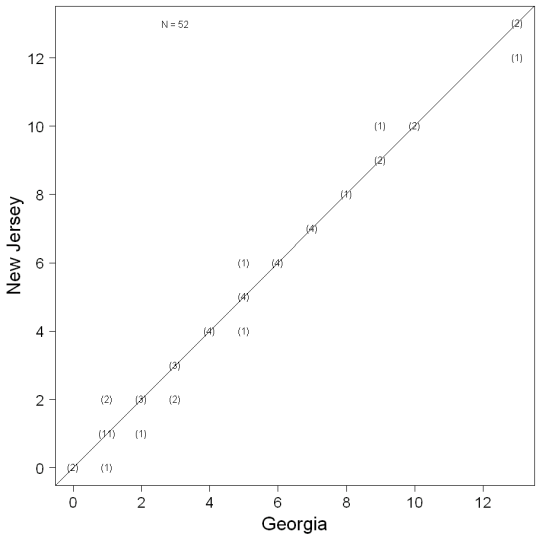
Figure 3: Age-bias plots for Atlantic croaker. Readings for each state are plotted against the readings for every other state. Numbers in parentheses indicate sample size at each point, N is the total sample size, and the solid line, y=x, indicates agreement between readings.

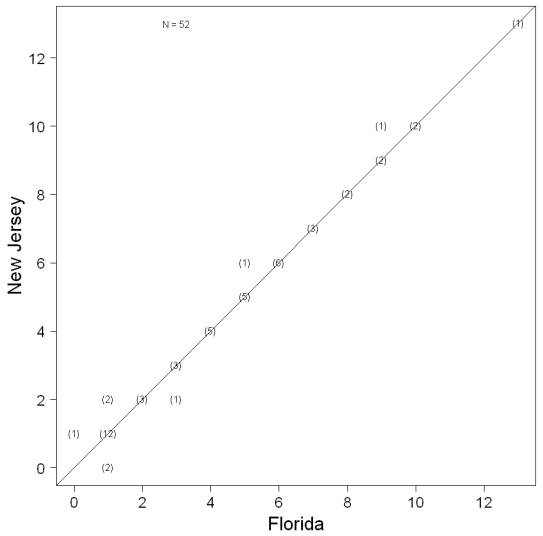
New Jersey

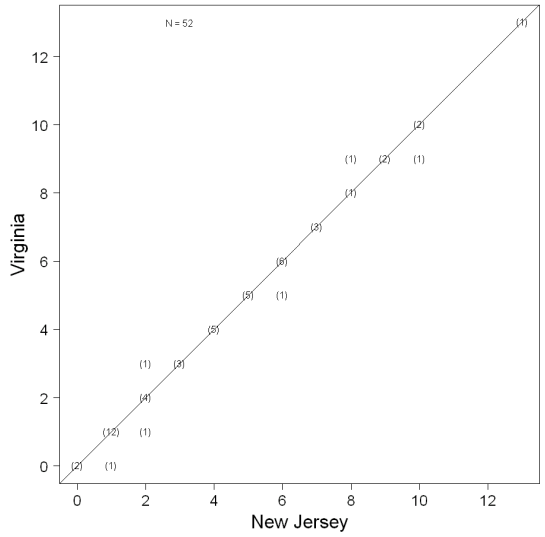








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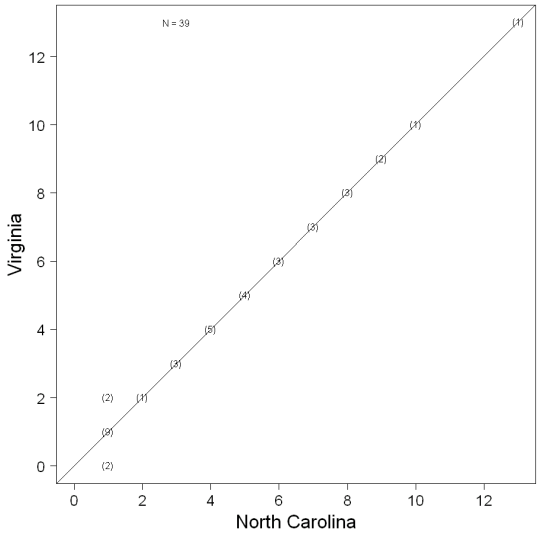
New Jersey

Virginia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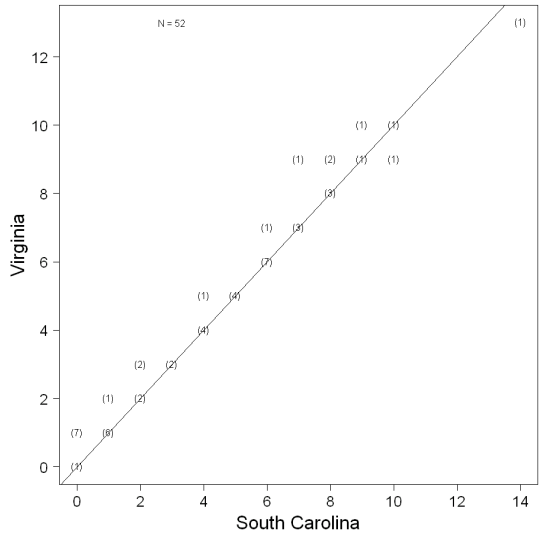
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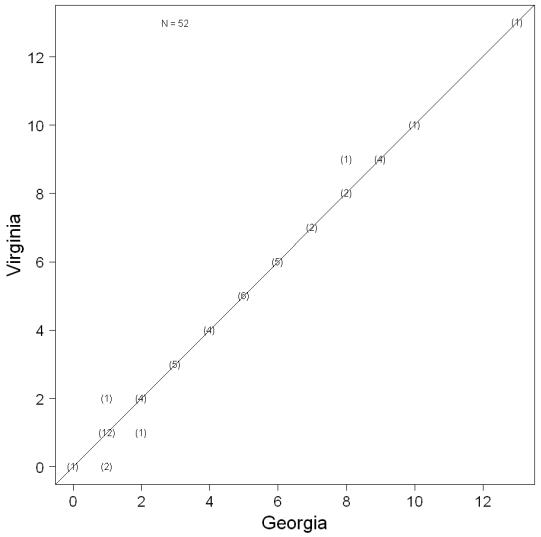
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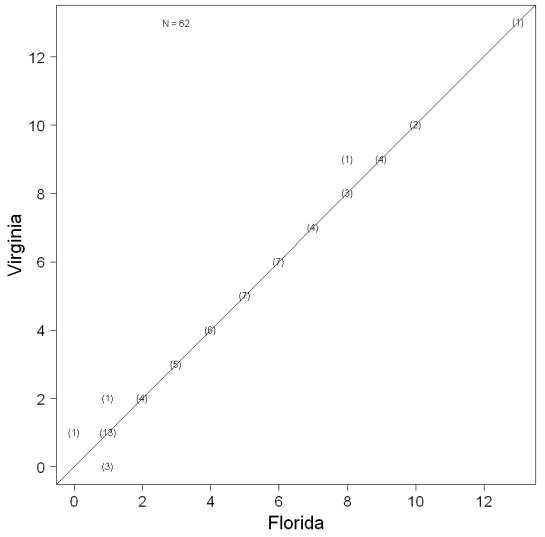
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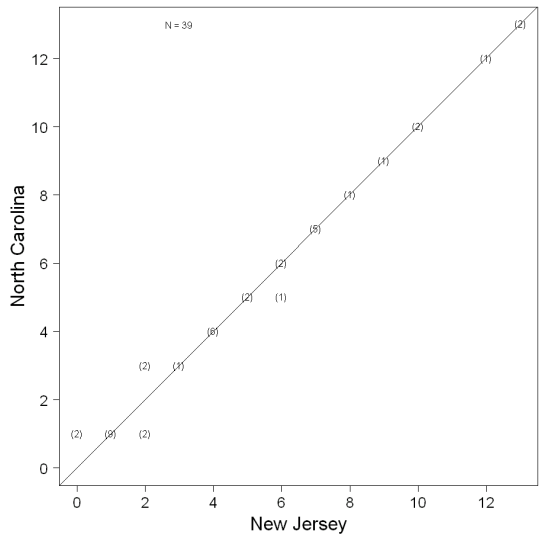

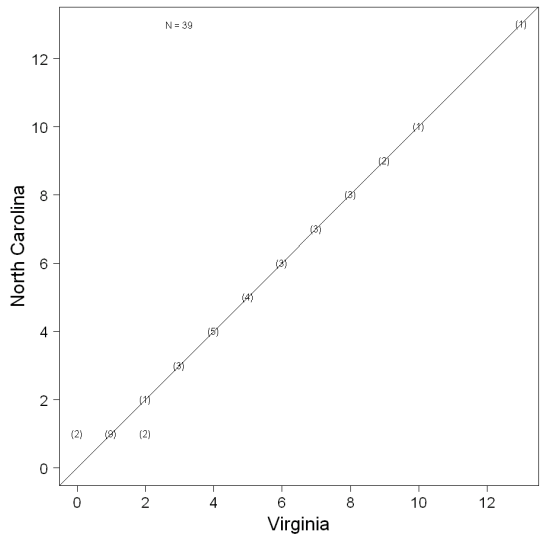

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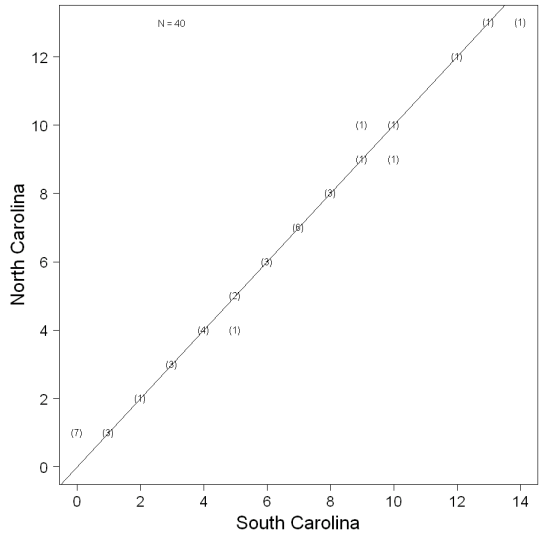
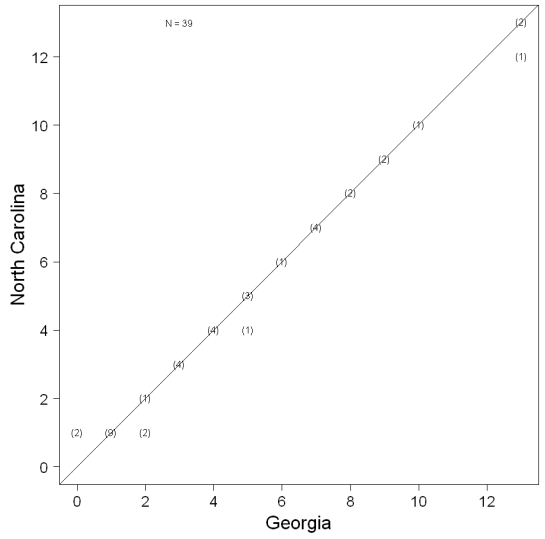
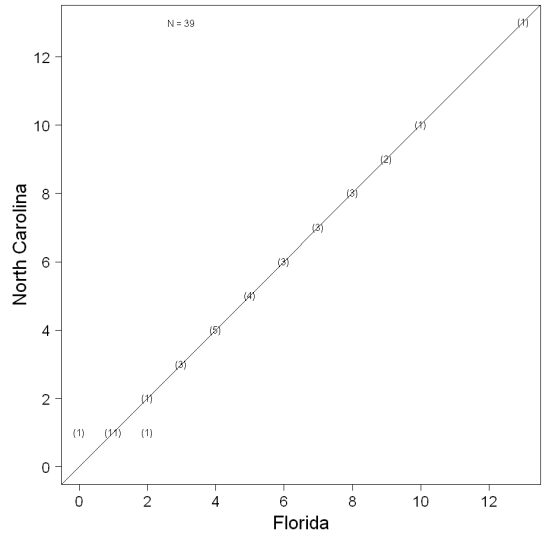
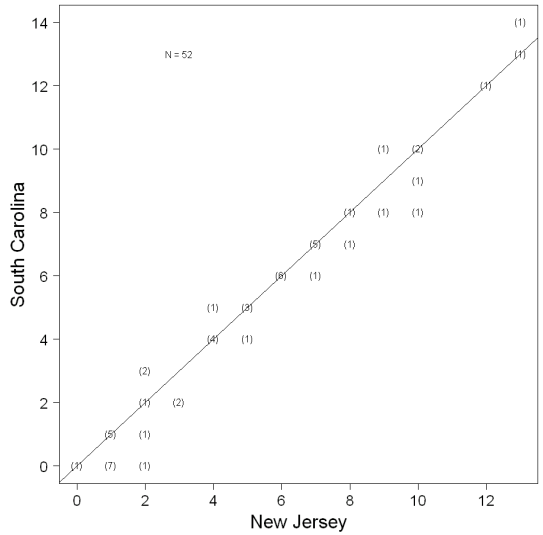
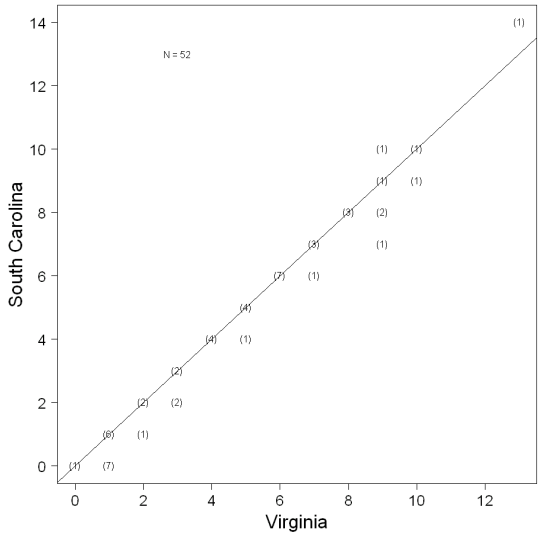
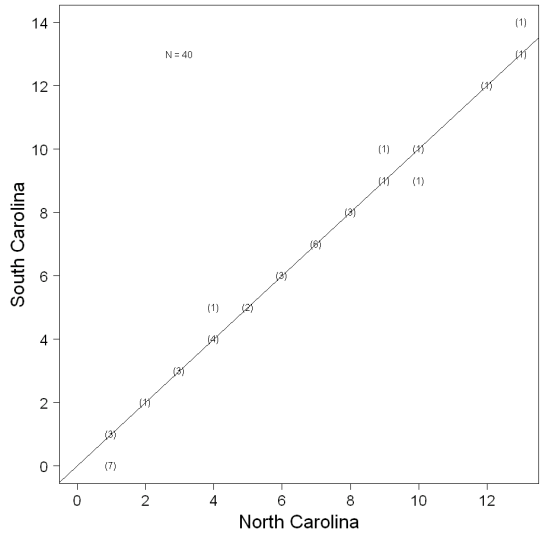




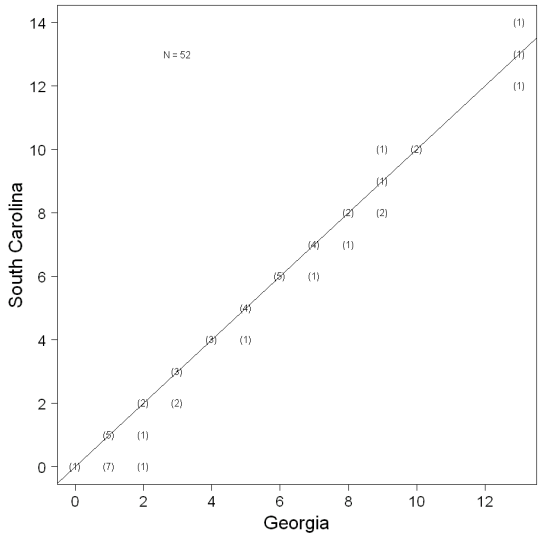


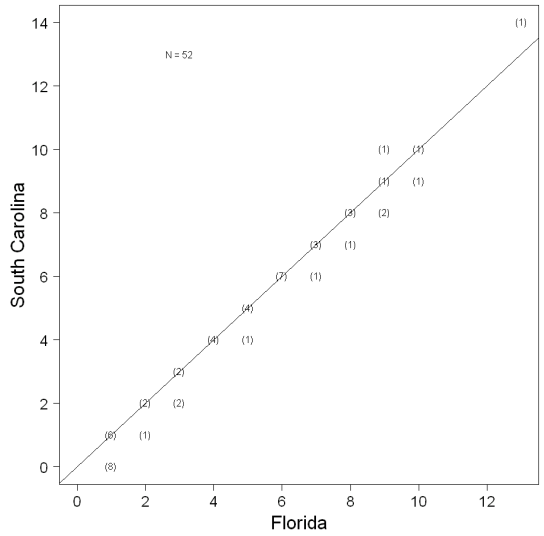


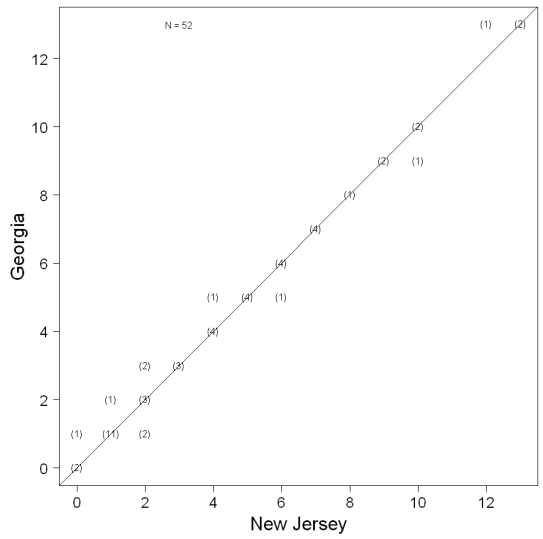




South Carolina



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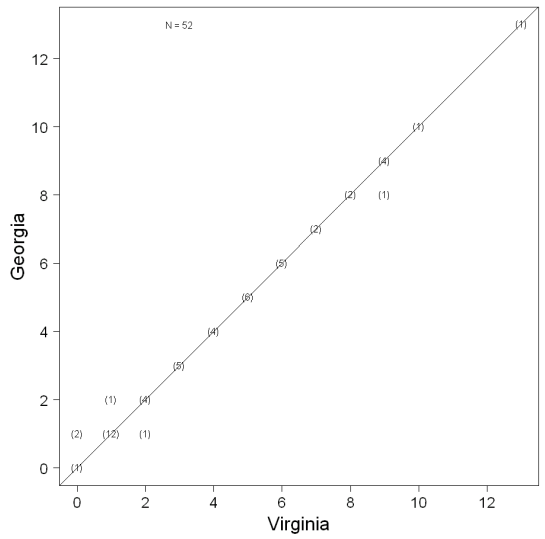
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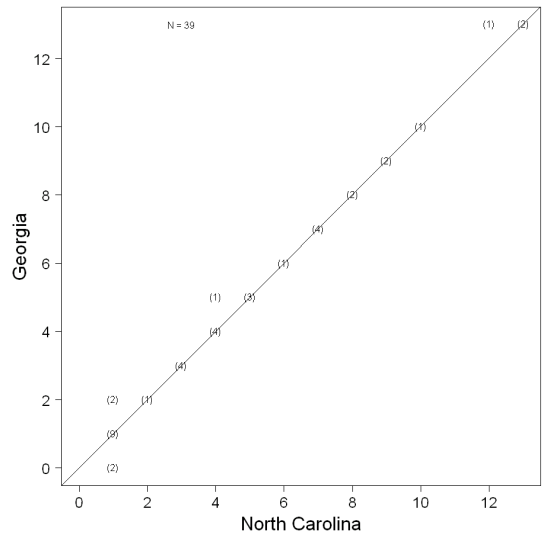
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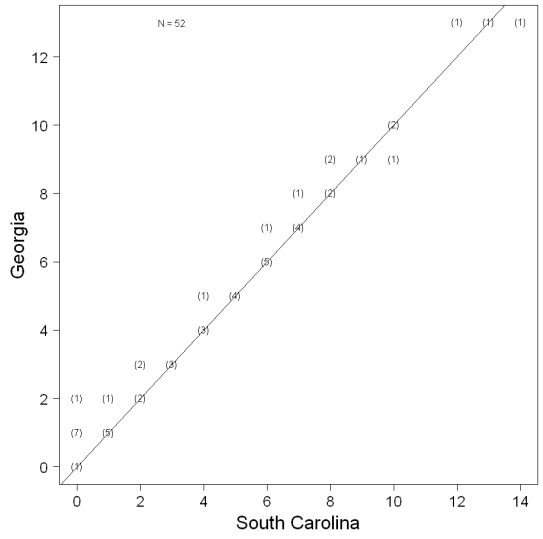
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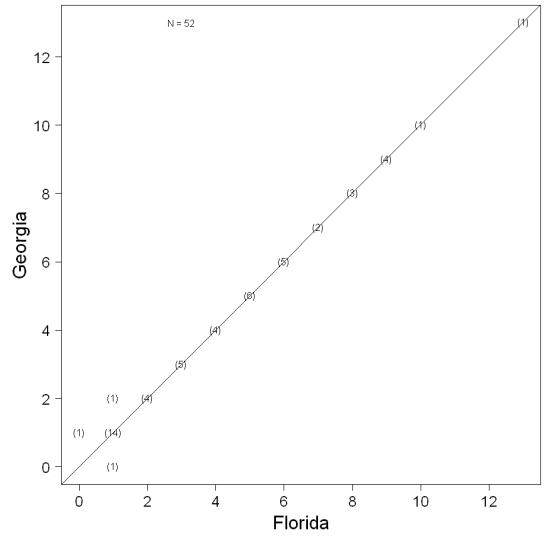
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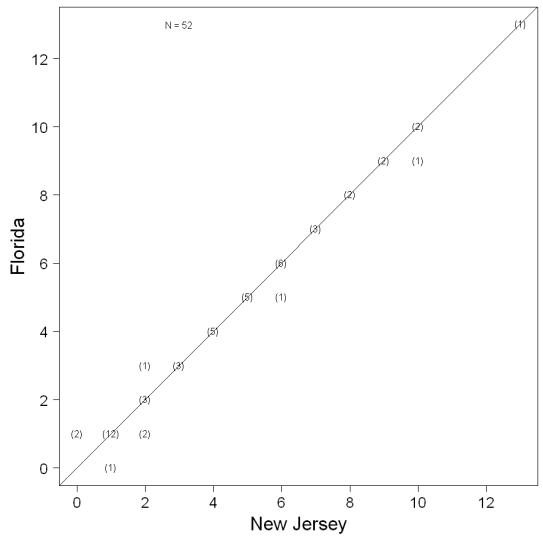
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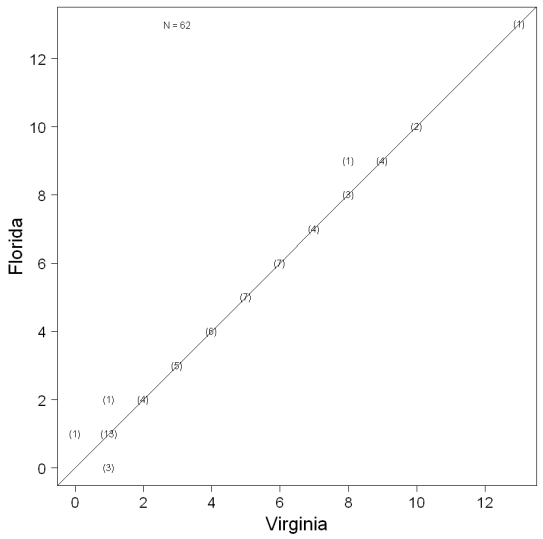
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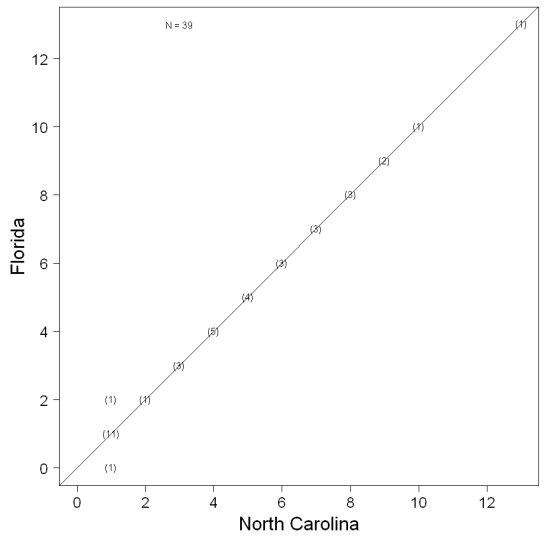
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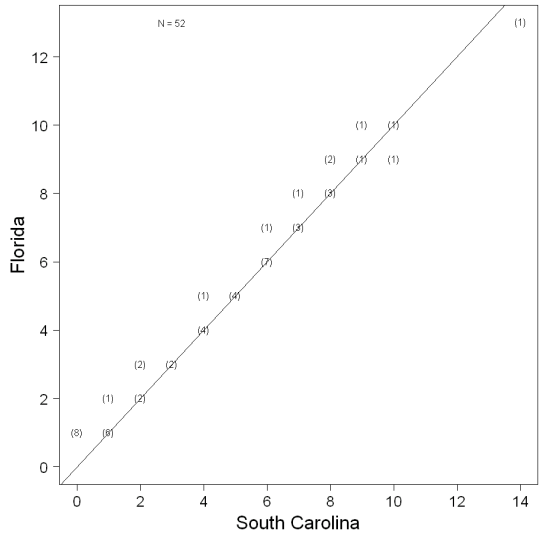
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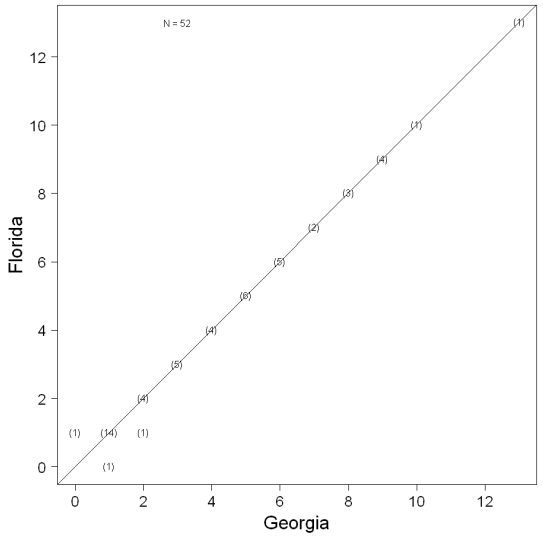
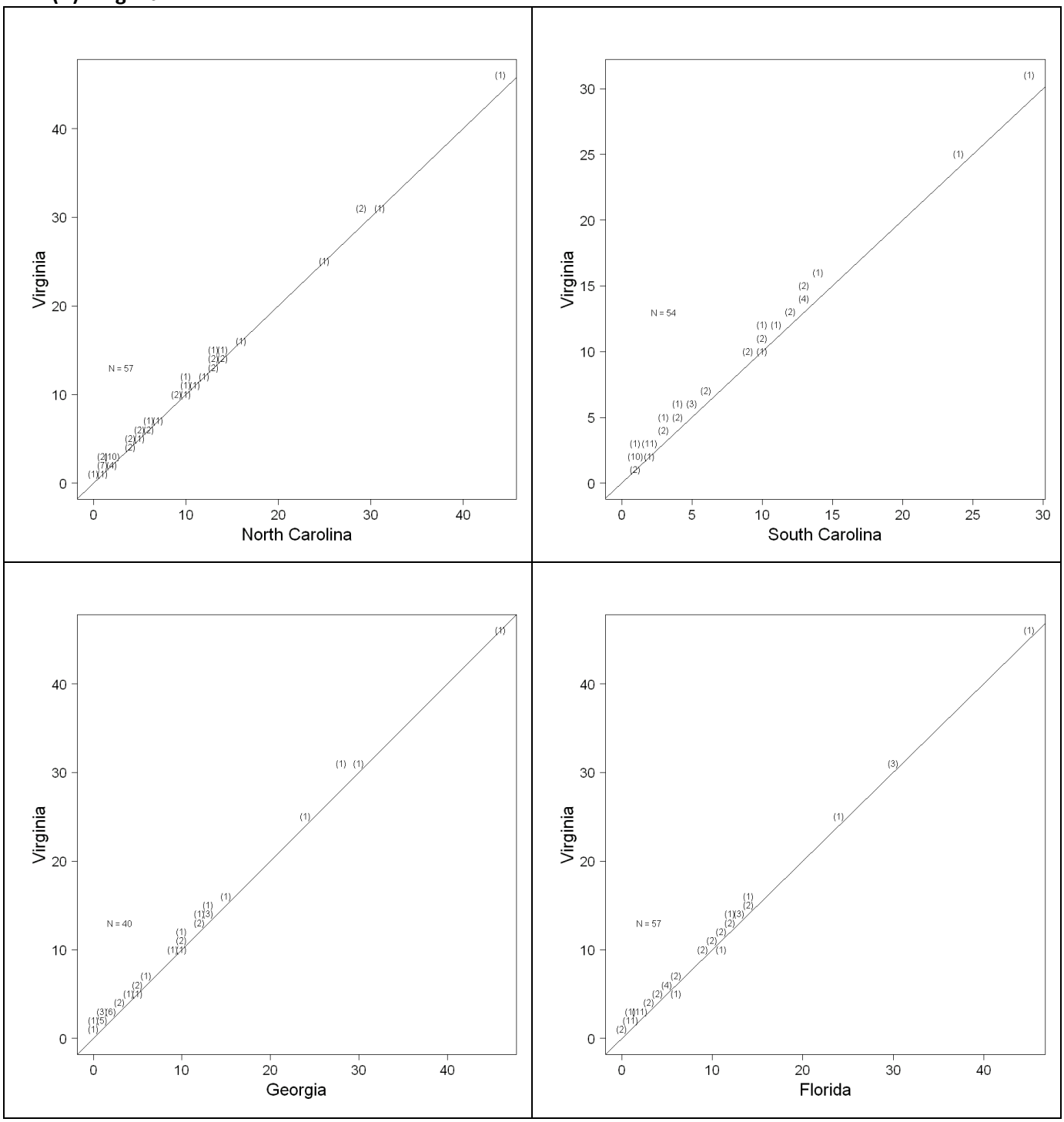

N = 52
Florida
Georgia

Florida

Figure 4: Age-bias plots for red drum. Readings for each state are plotted against the readings for every other state. Numbers in parentheses indicate sample size at each point, N is the total sample size, and the solid line, y=x, indicates agreement between readings.

(A) Virginia



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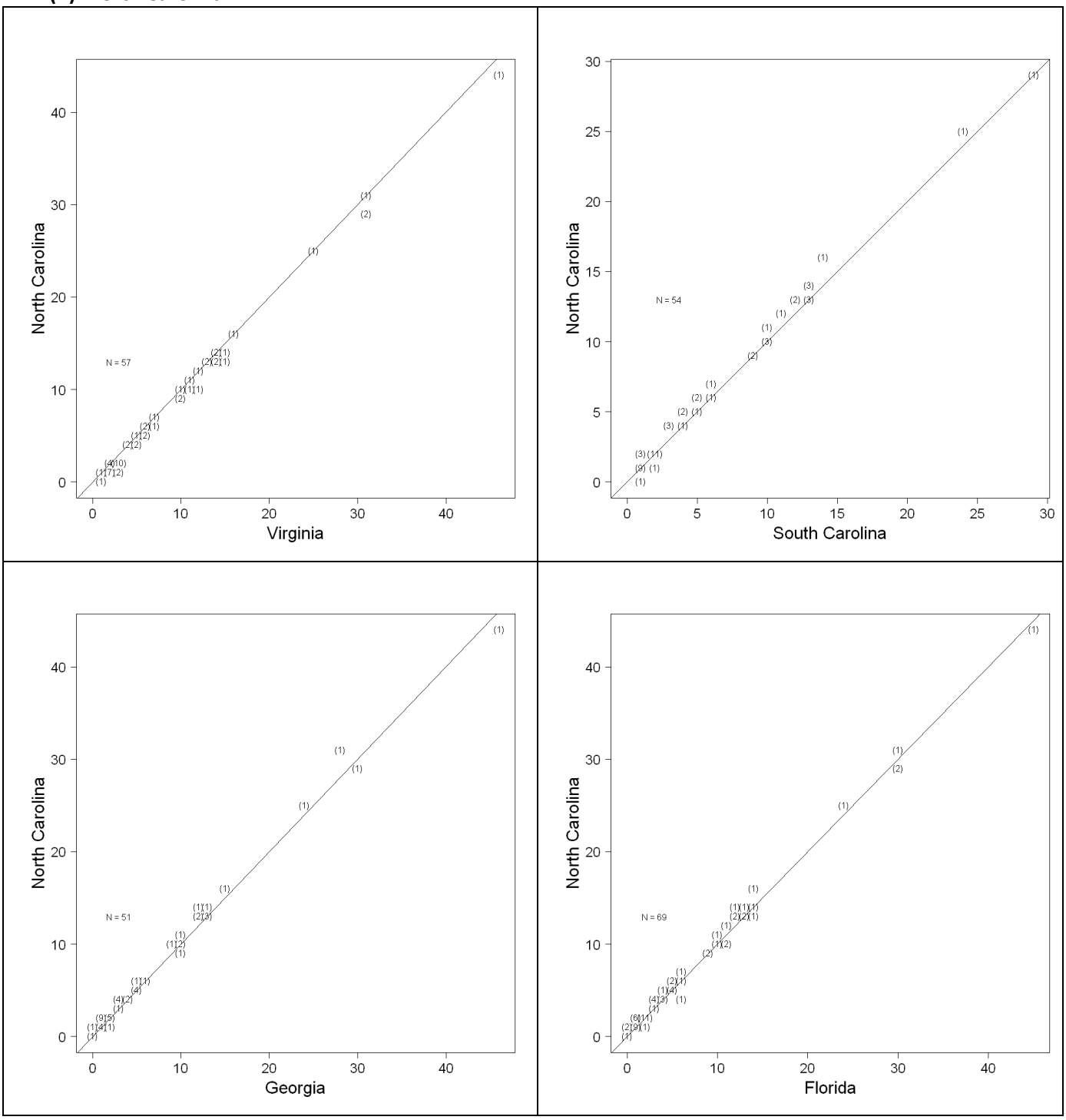

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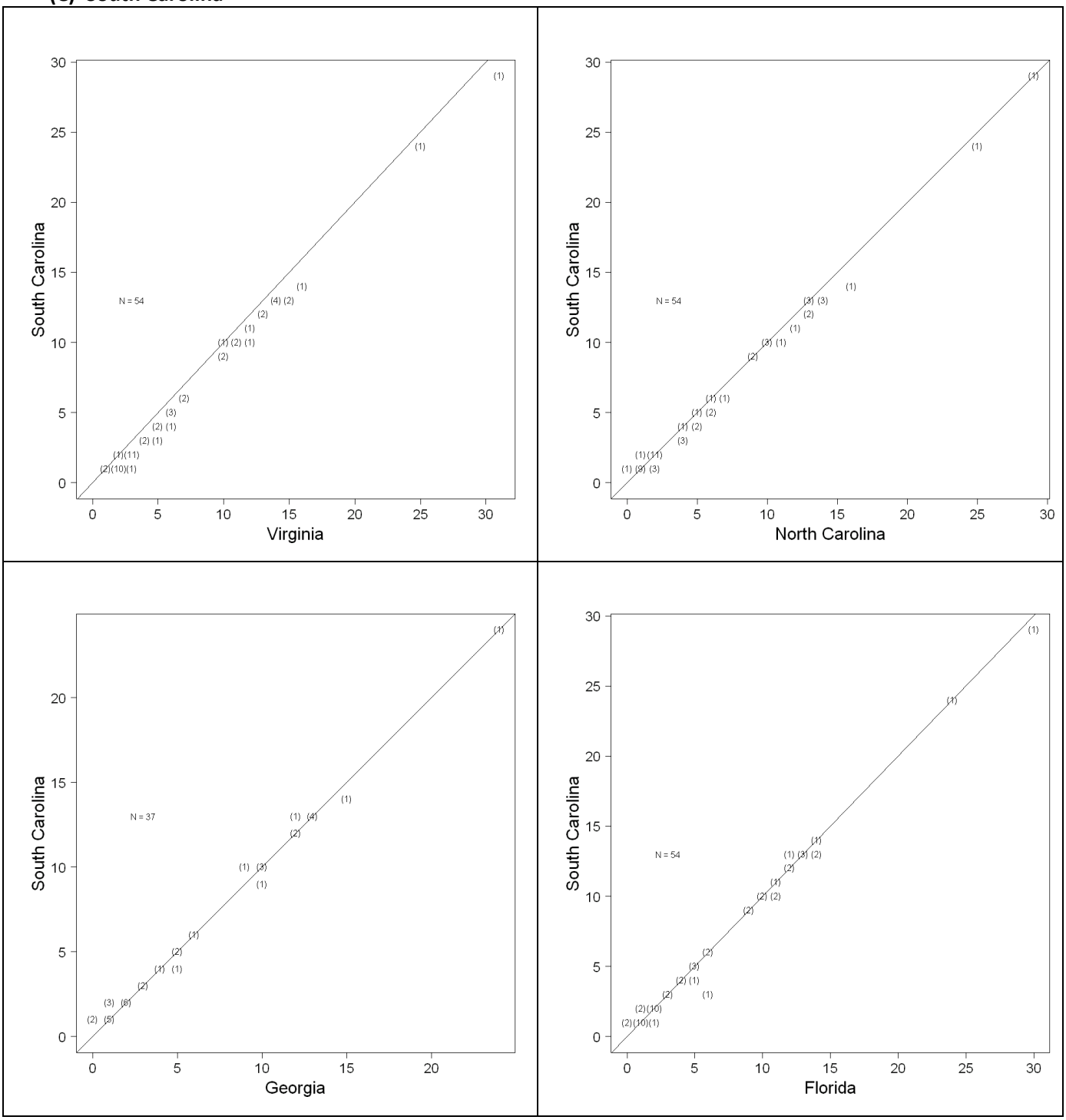

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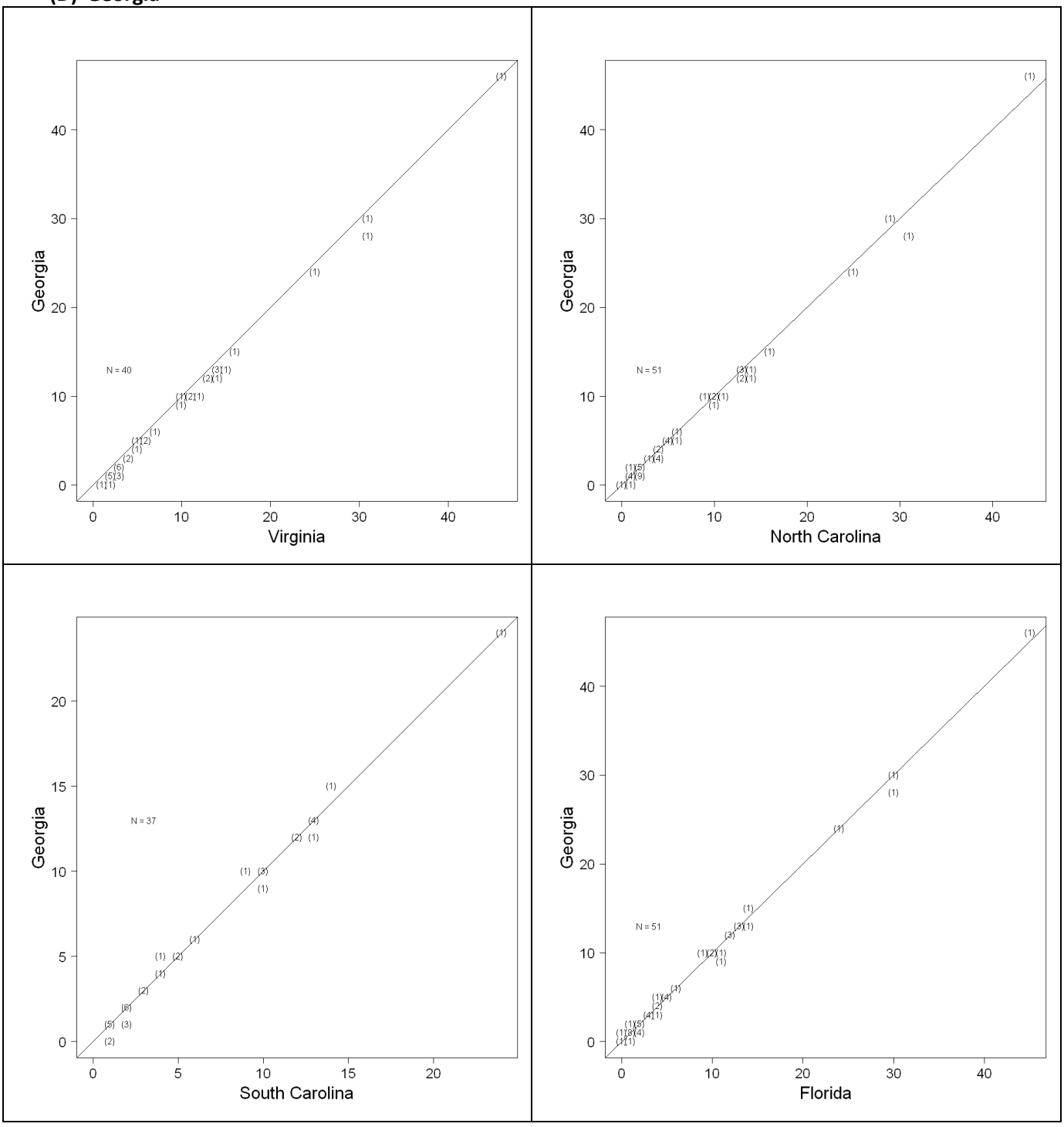
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Florida
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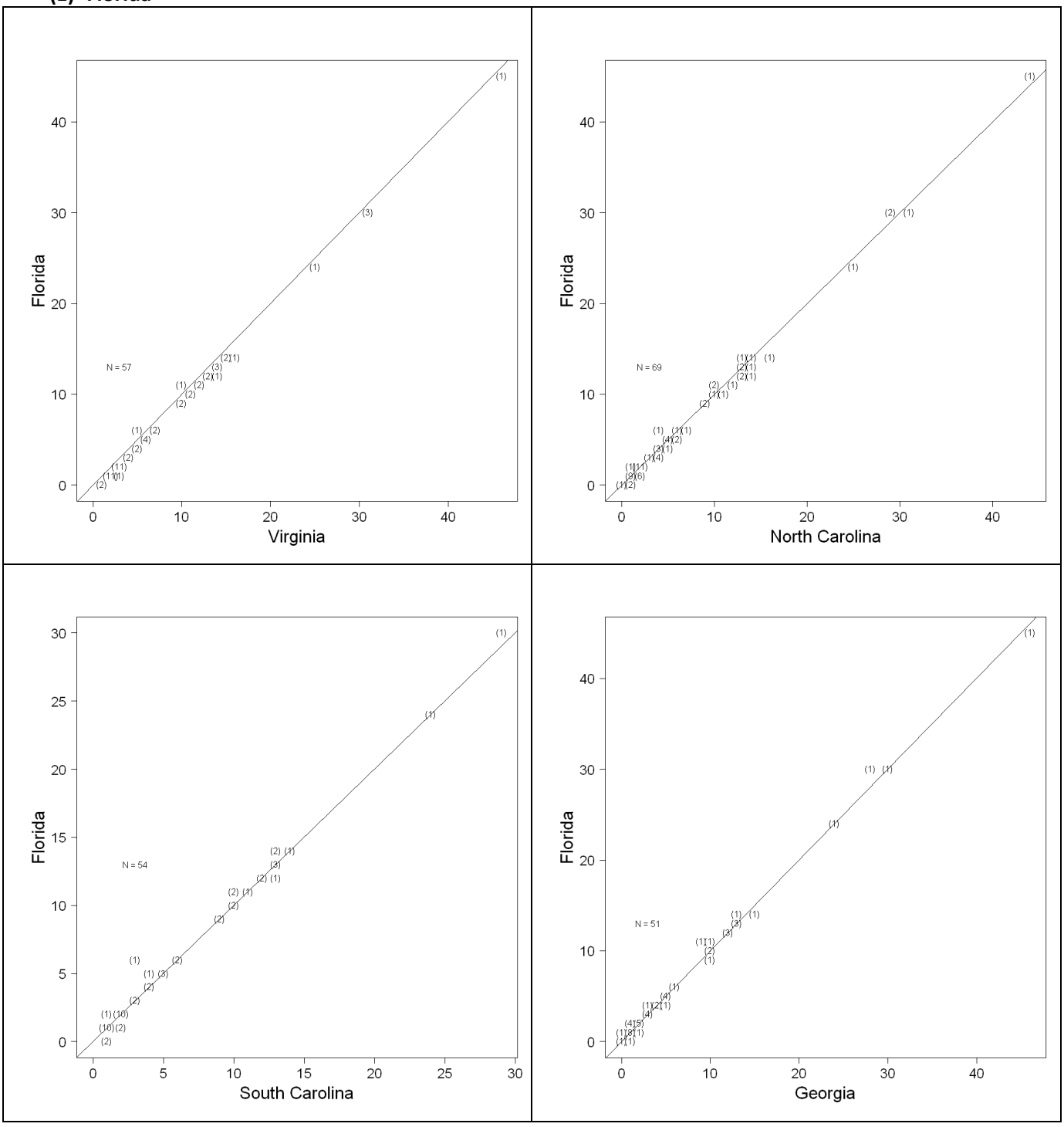
(E) Florida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